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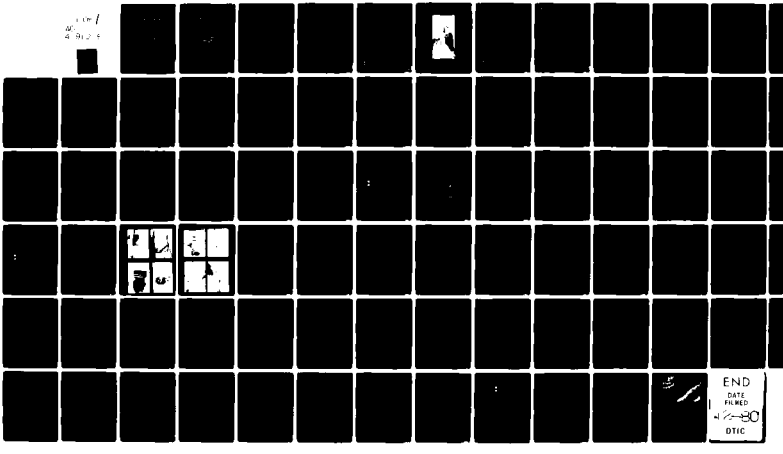

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SUSQUEHANNA RIVER BASIN

FALLS CREEK, LUZERNE COUNTY

(1)

AD A091265

PENNSYLVANIA

LAKE CATALPA DAM

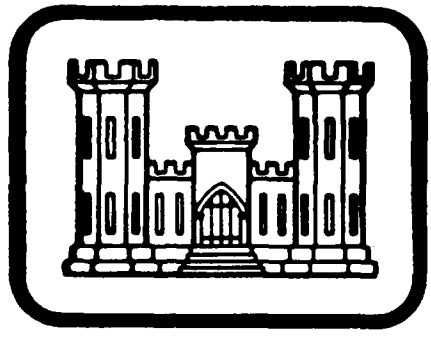
NDS ID NO. PA-560

DER ID NO. 40-57

LEVEL II

A. G. NESBIT III

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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Prepared By

L. ROBERT KIMBALL & ASSOCIATES

CONSULTING ENGINEERS & ARCHITECTS

EBENSBURG, PENNSYLVANIA

15931

DACW31-80-C-0020

FOR

DEPARTMENT OF THE ARMY

BALTIMORE DISTRICT CORPS OF ENGINEERS

BALTIMORE, MARYLAND

21203

411059

SEPTEMBER, 1980

SUSQUEHANNA RIVER BASIN
FALLS CREEK, LUZERNE COUNTY

PENNSYLVANIA

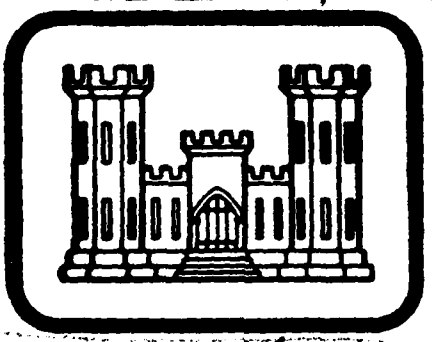
LAKE CATALPA DAM

NDS-ID NO. PA-560
DER-ID NO. 40-57

~~A. G. NESBIT III~~

PHASE I INSPECTION REPORT

~~NATIONAL DAM INSPECTION PROGRAM~~



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FOR

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21203

SEPTEMBER, 1980

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in detemining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM INSPECTION REPORT

NAME OF DAM	Lake Catalpa Dam
STATE LOCATED	Pennsylvania
COUNTY LOCATED	Luzerne
STREAM	Falls Creek
COORDINATES	Lat: 41° 23.6' Long: 75° 59.6'
DATE OF INSPECTION	May 20, 1980 and July 30, 1980

ASSESSMENT

The assessment of Lake Catalpa Dam is based upon visual observations made at the time of inspection, review of available records and data, hydraulic and hydrologic computations and past operational performance. The inspection and review of the data of Lake Catalpa Dam did not reveal any immediate problems which require emergency action. The dam appears to be in good condition and adequately maintained.

Lake Catalpa Dam is a high hazard-intermediate size dam. The spillway design flood (SDF) for a dam of this size and classifications is the PMF. The spillway and reservoir are capable of controlling approximately 33% of the PMF. Based on criteria established by the Corps of Engineers, the spillway is termed inadequate.

The following recommendations and remedial measures should be instituted immediately.

1. A detailed hydrologic and hydraulic analysis should be conducted by a registered professional engineer knowledgeable in dam design and construction to increase the spillway capacity of the dam. Recommendations resulting from this study should be implemented immediately.

2 The maintenance schedule and procedures presently in use should be continued. The existing crack in the concrete on the downstream face of the dam should be monitored on a regular basis and repaired if the monitoring program indicates that the crack is enlarging.

3. The rigid fish screen which spans the spillway crest blocks free access of flow to the spillway. The screen should be removed. A method should be developed to stop debris from blocking the spillway culvert and one which does not effect free discharge at the spillway.

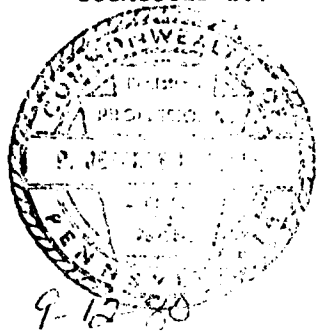
4. Develop a warning system to warn downstream residents in event of large spillway discharges or imminent failure of the dam.

LAKE CATALPA DAM
PA 560

5. A safety inspection program should be implemented with inspections at regular intervals by qualified personnel.

SUBMITTED BY:

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS AND ARCHITECTS



9-12-80

Date

R. Jeffrey Kimball

R. Jeffrey Kimball, P.E.

APPROVED BY:

24 Sep 1980

Date

James W. Peck

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

Overview of Lake Catalpa

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APPENDICES

PHASE I
NATIONAL DAM INSPECTION PROGRAM
LAKE CATALPA DAM
NDI. I.D. NO. PA 560
DER I.D. NO. 40-57

SECTION 1
PROJECT INFORMATION

1.1 General.

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Lake Catalpa Dam is an earthen embankment with dry masonry walls on both the upstream and downstream sides. Portions of the downstream slope have been replaced with concrete walls. The maximum height is 23 feet. The crest width ranges from 27.5 feet to 30 feet, the crest length is 160 feet. A paved road passes over the crest of the dam. Parapet walls are present both upstream and downstream above the roadway elevation. The reservoir drain is operated by a sluice gate located in the valve house and consists of a 30" pipe of unknown material. The sluice gate is operated and lubricated both in the spring and fall of each year. The sluice gate controls flow through the drainline which passes through the embankment.

The spillway is a three sided weir structure placed against the upstream wall with a total crest length of 26 feet. The weir crest is formed by an ogee crest with fish screens along the entire length. The ogee slopes to the entrance of a tunnel through the dam. The tunnel is 6 feet wide and 8.1 feet to 12.7 feet high. The tunnel discharges into an open rectangular shaped channel, at the downstream end of the structure. This rectangular channel continues for about 20 feet where it discharges into a tributary of Leonard Creek.

Concrete buttresses were added to the structure and portions of the downstream slope masonry was replaced with concrete in 1966.

b. Location. The dam is located on Falls Creek, a tributary to Leonard's Creek, Luzerne County, Pennsylvania. Lake Catalpa Dam can be located on the Center Moreland, U.S.G.S. 7.5 minute quadrangle.

c. Size Classification. Lake Catalpa Dam is an intermediate size structure (23 feet high, 1031 acre-feet).

d. Hazard Classification. The hazard classification for Lake Catalpa Dam was determined to be high. Downstream conditions at the time of inspection indicated that loss of more than a few lives is probable should the structure fail. Several homes are located approximately one mile downstream of the dam.

e. Ownership. Lake Catalpa Dam is owned by Abraham Nesbitt, III. Correspondence should be addressed to:

Abraham Nesbitt, III
R.D. #1
Dallas, Pennsylvania 18612
717-639-5492

f. Purpose of Dam. The dam was originally constructed to furnish mill power for a small saw mill and as a private ice supply. Currently the dam is used for fishing and recreation.

g. Design and Construction History. The dam was originally constructed in 1860 by Elijah Harris. The dam was rebuilt in the fall of 1929. The roadway across the crest of the dam was constructed at this time. According to information in the PennDER files the upstream masonry wall was continued down into the old fill material as a corewall and tied into rock for most of its length. Concrete buttresses and concrete walls were added to the structure in 1966 by the Sardoni Construction Company. The repairs to the dam were designed by Mr. John M. Coon an architect from Luzerne, Pennsylvania.

h. Normal Operating Procedures. The owner of the dam accompanied the inspection team on the inspection of the dam and stated that regular maintenance is conducted on the dam. It was determined that the fish screens are cleaned daily in the spring and every 10 days in the summer. Maintenance on the concrete walls is completed on an unscheduled basis. In 1979 epoxy was applied to the upstream wall. The reservoir drainline is reportedly operated and lubricated in the spring and fall of each year.

1.3 Pertinent Data.

a. Drainage Area. 2.1 square miles

b. Discharge at Dam Site (cfs).

Maximum flood at dam site	Unknown
Drainline capacity at normal pool	Unknown
Spillway capacity at top of dam	723

c. Elevation (U.S.G.S. Datum) (feet). - Based on assumed spillway crest elevation of 1270 estimated from U.S.G.S. 7.5 minute quadrangle.

Top of dam - low point	1275.4
Top of dam - design height	Unknown
Normal pool	1270
Ogee spillway crest	1269.5
Sharp crest weir (rigid fish screen)	1271.5
Upstream invert of spillway	1265.4
Downstream invert of spillway	1260.9
Maximum tailwater	Unknown
Toe of dam	1254.6

d. Reservoir (feet).

Length of maximum pool	3400 feet
Length of normal pool	3250 feet

e. Storage (acre-feet).

Normal pool	529
Top of dam	1031

f. Reservoir Surface (acres).

Top of dam	145
Normal pool	115
Spillway crest	15

g. Dam.

Type	Earthfill with masonry and concrete walls
Length	160 feet
Height	23 feet
Top width	27.5 to 30 feet
Side slopes - upstream	Vertical
- downstream	Vertical
Zoning	Unknown
Impervious core	Upstream concrete wall
Cutoff	Unknown
Grout curtain	None

h. Reservoir Drain.

Type	30" pipe (Unknown material)
Length	Unknown
Closure	Sluice gate
Access	Valve house upstream
Regulating facilities	Sluice gate

i. Spillway.

Type	Concrete ogee to sharp crested weir
Length	26 feet
Ogee crest elevation	1269.5
Sharp crest weir (rigid fish screen)	1271.5
Upstream channel	Lake
Downstream channel	Reinforced concrete channel for approximately 20 feet

Note: Spillway crest is ogee shaped with a rigid fish screen along its entire length.

SECTION 2
ENGINEERING DATA

2.1 Design. Some correspondence and inspection reports were available for review in the PennDER files. No construction plans or structural details were available.

2.2 Construction. Very little information was available on the construction of the dam. Several inspection reports exist in the PennDER files. These indicate that the structure was built in 1860 and rebuilt in 1927. According to information in the files the upstream concrete wall extends through the original embankment to a rock foundation to provide an impervious cutoff. The owner indicated that maintenance construction was completed in 1966, including installation of concrete buttresses and concrete walls. This construction was done by Sardoni Construction Company. The design work relative to the 1966 modifications was completed by John M. Coon an architect from Luzerne, Pennsylvania.

2.3 Operation. No operating records are known to exist. The owner indicates that the fish screens are cleaned daily in the spring and approximately every ten days during the summer months. The owner also lubricates and operates the sluice gate valves in the spring and fall of each year.

2.4 Evaluation.

a. Availability. Engineering data was provided by PennDER, Bureau of Dams and Waterway Management. The owner was available for interview and he informed the inspection team of current maintenance and operating procedures. The owner also indicated that maintenance construction was done in 1966.

b. Adequacy. No design data was available for review for the purposes of this report. Minimal information was available concerning the upkeep of the dam, and overall history. This Phase I report is based on visual inspections, hydrologic and hydraulic analysis. Sufficient information exists to complete a Phase I report.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The onsite inspection of Lake Catalpa Dam was conducted by personnel of L. Robert Kimball and Associates on May 20, 1980 and August 30,1980. The inspection consisted of:

1. Visual inspection of the retaining structure, abutments and toe.
2. Examination of the spillway facilities, exposed portion of any outlet works and other appurtenant works.
3. Observations affecting the runoff potential of the drainage basin.
4. Evaluation of the downstream area hazard potential.

b. Dam. The dam appeared to be in good condition. From a brief survey conducted during the inspection it was noted that the crest elevation of the structure is generally consistent. A low spot exists on the right abutment and was considered the top of dam for our analysis. The crest width was measured to be between 27.5 and 30 feet. The dam length is approximately 160 feet. An earth core is supported by vertical masonry wall on both the upstream and downstream sides. The most recent inspection of the structure was in 1944. That inspection report noted slight settlement and cracking of the upstream wall about 20 feet left of the spillway. Also noted in that inspection report was some seepage through the masonry structure. This inspection noted some cracking near the center of the dam.

c. Appurtenant Structures. The water level at the time of inspection was estimated to be 1270. The spillway appears to be in good condition. The entire crest of the spillway was topped with a rigid steel frame fish screen two feet high. This fish screen is reportedly cleaned and maintained on a regular basis. However in the event of major flooding the screen would become clogged, therefore in our analysis of the spillway the crest was considered to be the top of the screen.

The drainline for the reservoir consists of a 30" pipe of unknown material operated by a sluice gate located in the valve house. This gate is reportedly lubricated and operated in the spring and fall of each year.

d. Reservoir Area. Most of the hillside slopes surrounding the pond are wooded and are moderately steep and rise to an elevation of 100 to 200 feet above the surface of the pond. The area seems to be fairly stable and not susceptible to massive landslides which would affect the storage volume or cause overtopping of the dam by displacing water.

e. Downstream Channel. Lake Catalpa Dam empties into Falls Creek. Falls Creek flows through a fairly steep and narrow valley for a distance of approximately 1 mile at which point it enters Leonard Creek. Leonard Creek then flows for approximately 4 miles and empties into Bowmans Creek, which in turn enters the North Branch of the Susquehanna River.

3.2 Evaluation. In general, the structure and outlet works appear to be in good condition. The drainline was not observed during the inspection.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures. Water level is maintained at an approximate elevation of 1270.0. The fish screen is reportedly maintained and cleaned on a regular basis. However in the event of major flooding, it could be assumed that this screen would clog with debris and that the effective spillway crest would be at elevation 1271.5.

4.2 Maintenance of the Dam. The concrete walls are maintained and repaired on an unscheduled basis. An epoxy mixture was applied to the upstream walls in 1979. The maintenance of the dam appears to be good.

4.3 Maintenance of Operating Facilities. The operating procedures for the dam and its facilities consist of regular cleaning and maintenance of the fish screens obstructing the spillway and the semi-annual maintenance and operation of the sluice gate. The overall condition of the facilities appeared good, although the gate was not operated at the time of inspection.

4.4 Warning System in Effect. There is no known warning system in effect to warn any downstream residents of large spillway discharges or imminent failure of the dam.

4.5 Evaluation. In general the maintenance of the operating facilities and dam appears to be good, however there is no known warning system in effect to warn downstream residents of large spillway discharges or imminent failure.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features.

a. Design Data. PennDER files contained no information concerning hydrologic and hydraulic design for these facilities. However, there exists a 1930 inspection report which sugests that the spillway without the fish screen would discharge some 1360 cfs, or about 650 cfs per square mile. The report continues and notes that it is doubtful that the tunnel entrance will take much more than half that quantity.

b. Experience Data. No rainfall, runoff or reservoir level data was available. It was indicated that the maximum waterlevel experienced was in 1972 during hurricane Agnes and that the water level reached the top of the fish screens. The spillway reportedly has functioned adequately in the past.

c. Visual Observations. The spillway appeared to be in good condition, although along the entire crest of the spillway there exists a rigid fish screen. In the event of a major flood this screen could become clogged with debris and the effective spillway crest elevation would be the top of the screens at an elevation of 1271.5.

d. Overtopping Potential. Overtopping potential was investigated through the development of the probable maximum flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway.

The Corps of Engineers, Baltimore District, has directed that the HEC-1 Dam Safety Version systemized computer program be utilized. The program was prepared by the Hydrologic Engineering Center (HEC), U.S. Army Corps of Engineers, Davis, California, July, 1978. The major methodologies or key input data for this program are discussed briefly in Appendix D.

5.2 Evaluation Assumptions. To enable us to complete the hydraulic and hydrologic analysis for this structure, it was necessary to make the following assumptions.

1. Pool elevation prior to the storm was at the top of the fish screen structure at elevation 1271.5.

2. Top of dam was considered to be the low spot elevation at the right abutment, 1275.4. The top of the parapet walls would generally be considered the top of dam.

3. Discharge through the drainline was not considered.

5.3 Summary of Overtopping Analysis. Complete summary sheets for the computer output are presented in Appendix D.

Peak inflow (PMF)	5740 cfs
Spillway capacity	723 cfs (top of screen normal pool)
Storage capacity	1031 ac-ft

a. Spillway Adequacy Rating. The Spillway Design Flood (SDF) for a dam of this size and classification is the PMF. Based on the following definition provided by the Corps of Engineers, the spillway is rated as inadequate.

> Inadequate - All intermediate high hazard dams which do not pass the spillway design flood (PMF).

The spillway and reservoir are capable of controlling 33% of the PMF storm without overtopping the dam.

5.4 Summary of Dam Breach Analysis. The subject dam cannot satisfactorily pass 50% of the PMF based on our analysis therefore it was necessary to perform the dam breach analysis and downstream routing of the flood wave. This analysis determined the degree of increased flooding due to dam failure.

A reservoir pool elevation of 1275.75 was considered sufficient to cause failure of the Lake Catalpa Dam. This elevation represents a depth of overtopping of approximately 0.35 foot over the low spot of the dam for a duration of approximately 4 hours.

The resulting flood wave was routed downstream with and without failure considerations. Downstream potential for loss of life and property damage is not significantly increased by dam failure. Therefore, the spillway is rated as inadequate. A detailed printout of the breach analysis is included in Appendix D.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. Minor concrete cracking was evident near the center of the dam in the masonry. The concrete and concrete buttresses appeared to be in good condition. No seepage was observed through the dam or at the toe of dam.

b. Design and Construction Data. No design or construction data existed in the PennDER files. There was a note in the DER files that some deterioration of the concrete did exist. This problem however has been repaired in the past and the present concrete is in good condition.

c. Operating Records. No operating records are known to exist. However, the owner indicated that regular cleaning and maintenance is done to the fish screen on the spillway crest, and that the sluice gate is operated and lubricated on a semi-annual basis.

d. Post Construction Changes. The dam was originally constructed in 1860. It was rebuilt in 1929 and additional concrete buttresses were added in 1966.

e. Seismic Stability. The dam is located in seismic zone 1. No seismic stability analyses has been performed. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake loading. No visual deficiencies were observed which would affect the stability of the dam. No stability analysis have been completed to date on this structure to document long-term stability.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The dam appears to be in good condition. No signs of immediate instability were observed during the inspection. Minor cracking is occurring near the center of the dam in the masonry on the downstream face of the dam. No seepage or erosion was noted at the time of inspection, however past inspections reports indicate that seepage and concrete deterioration existed. Lake Catalpa is capable of controlling approximately 33% of the PMF. The spillway is rated as inadequate but not seriously inadequate.

b. Adeqacy of Information. This Phase I report is based on the visual inspection and a hydrologic and hydraulic analysis. Sufficient information is available to complete a Phase I Report.

c. Urgency. The recommendations suggested below should be implemented immediately.

d. Necessity for Further Investigation. In order to accomplish some of the recommendations/remedial measures outlined below, further investigations will be required.

7.2 Recommendations/Remedial Measures.

1. A detailed hydrologic and hydraulic analysis should be conducted by a registered professional engineer knowledgeable in dam design and construction to increase the spillway capacity of the dam. Recommendations resulting from this study should be implemented immediately.

2 The maintenance schedule and procedures presently in use should be continued. The existing crack in the concrete on the downstream face of the dam should be monitored on a regular basis and repaired if the monitoring program indicates that the crack is enlarging.

3. The rigid fish screen which spans the spillway crest blocks free access of flow to the spillway. The screen should be removed. A method should be developed to stop debris from blocking the spillway culvert and one which does not effect free discharge at the spillway.

4. Develop a warning system to warn downstream residents in event of large spillway discharges or imminent failure of the dam.

5. A safety inspection program should be implemented with inspections at regular intervals by qualified personnel.

APPENDIX A
CHECKLIST, VISUAL INSPECTION, PHASE I

CHECK LIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Lake Catalpa COUNTY Luzerne STATE Pennsylvania ID# PA 560

TYPE OF DAM Earthfill with concrete masonry walls HAZARD CATEGORY High

DATE(s) INSPECTION May 20, 1980
July 30, 1980 WEATHER Seasonal TEMPERATURE Seasonal

POOL ELEVATION AT TIME OF INSPECTION 1270 M.S.L. TAILWATER AT TIME OF INSPECTION _____ M.S.L.

INSPECTION PERSONNEL:

R. Jeffrey Kimball, P.E. - L. Robert Kimball and Associates

James T. Hockensmith - L. Robert Kimball and Associates

O.T. McConnell - L. Robert Kimball and Associates

Cameron R. Mock - L. Robert Kimball and Associates

Jan Nesbitt - Owner John Coon - Coon Construction Company

James T. Hockensmith
RECORDER

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	Minor cracking in the center of the structure on the downstream face of the dam.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	No observed deficiencies. Low spot on right abutment.	
RIPRAP FAILURES	None.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	None.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Appears to be good.	
ANY NOTICEABLE SEEPAGE	None.	
STAFF GAUGE AND RECORDER	None.	
DRAINS	Appear to be in good condition.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	Not applicable.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Not applicable.	
DRAINS	Not applicable.	
WATER PASSAGES	Not applicable.	
FOUNDATION	Not applicable.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Not applicable.	
STRUCTURAL CRACKING	Not applicable.	
VERTICAL AND HORIZONTAL ALIGNMENT	Not applicable.	
MONOLITH JOINTS	Not applicable.	
CONSTRUCTION JOINTS	Not applicable.	
STAFF GAUGE OR RECORDER	Not applicable.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None observed.	
INTAKE STRUCTURE	Good condition.	
OUTLET STRUCTURE	Good condition.	
OUTLET CHANNEL	Good condition.	
EMERGENCY GATE	Not operated during inspection. Reportedly in good condition.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Concrete structure, ogee shaped weir. Appears to be in good condition. A fish screen spans the structure and should be removed.	
APPROACH CHANNEL	Lake - unrestricted.	
DISCHARGE CHANNEL	Rectangular shaped concrete structure exiting into natural drainage.	
BRIDGE AND PIERS	Roadway over the crest.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Not applicable.	
APPROACH CHANNEL	Not applicable.	
DISCHARGE CHANNEL	Not applicable.	
BRIDGE AND PIERS	Not applicable.	
GATES AND OPERATION EQUIPMENT	Not applicable.	

DOWNSTREAM CHANNEL

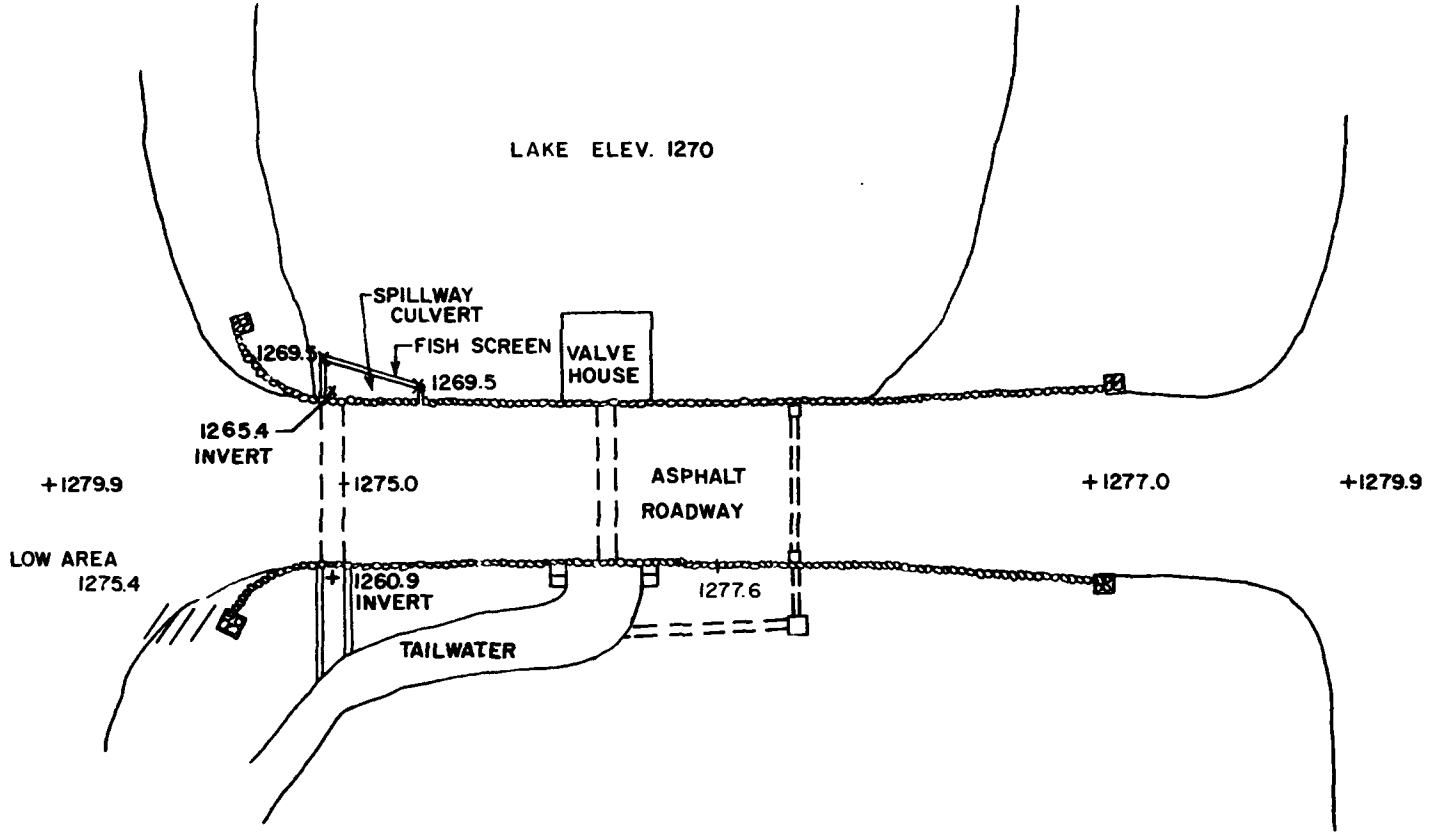
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The exit channel empties into Falls Creek and flows through a fairly steep and narrow channel for a distance of about 1 mile then enters into Leonard Creek and Bowman Creek and eventually into the north branch of the Susquehanna River.	
SLOPES	Fairly steep.	
APPROXIMATE NO. OF HOMES AND POPULATION	Several homes - 10 people - are located approximately 1 mile downstream of the dam.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Fairly steep. Stable.	
SEDIMENTATION	Unknown.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	



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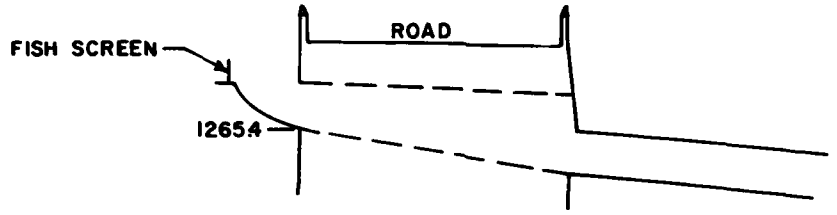
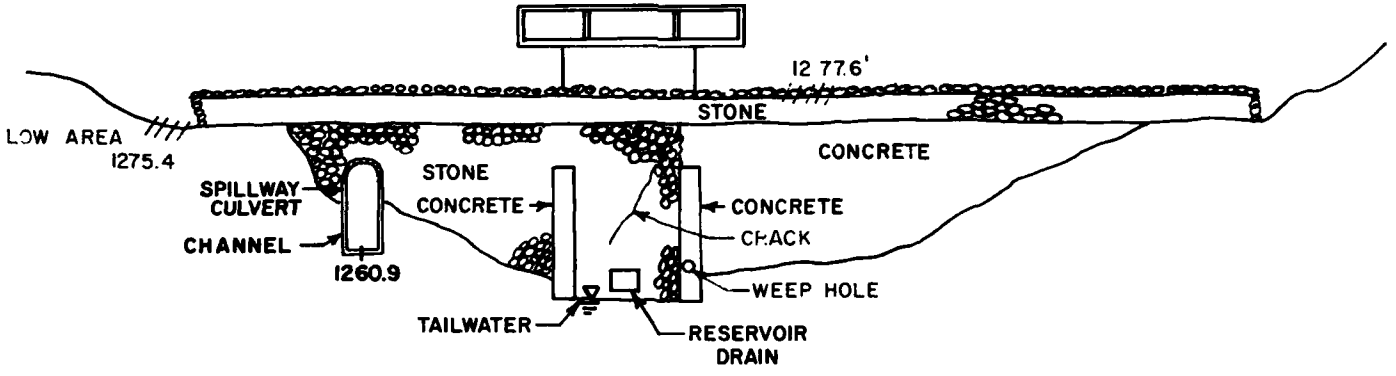
LAKE CATALPA DAM

Scale: 1" = 30'



SPILLWAY CULVERT
Scale: 1"=20'



PROFILE
LOOKING UPSTREAM
Scale: 1"=20'

LAKE CATALPA DAM

A-13

APPENDIX B
CHECKLIST, ENGINEERING DATA, DESIGN, CONSTRUCTION, OPERATION, PHASE I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Lake Catalpa Dam

ID# PA 560

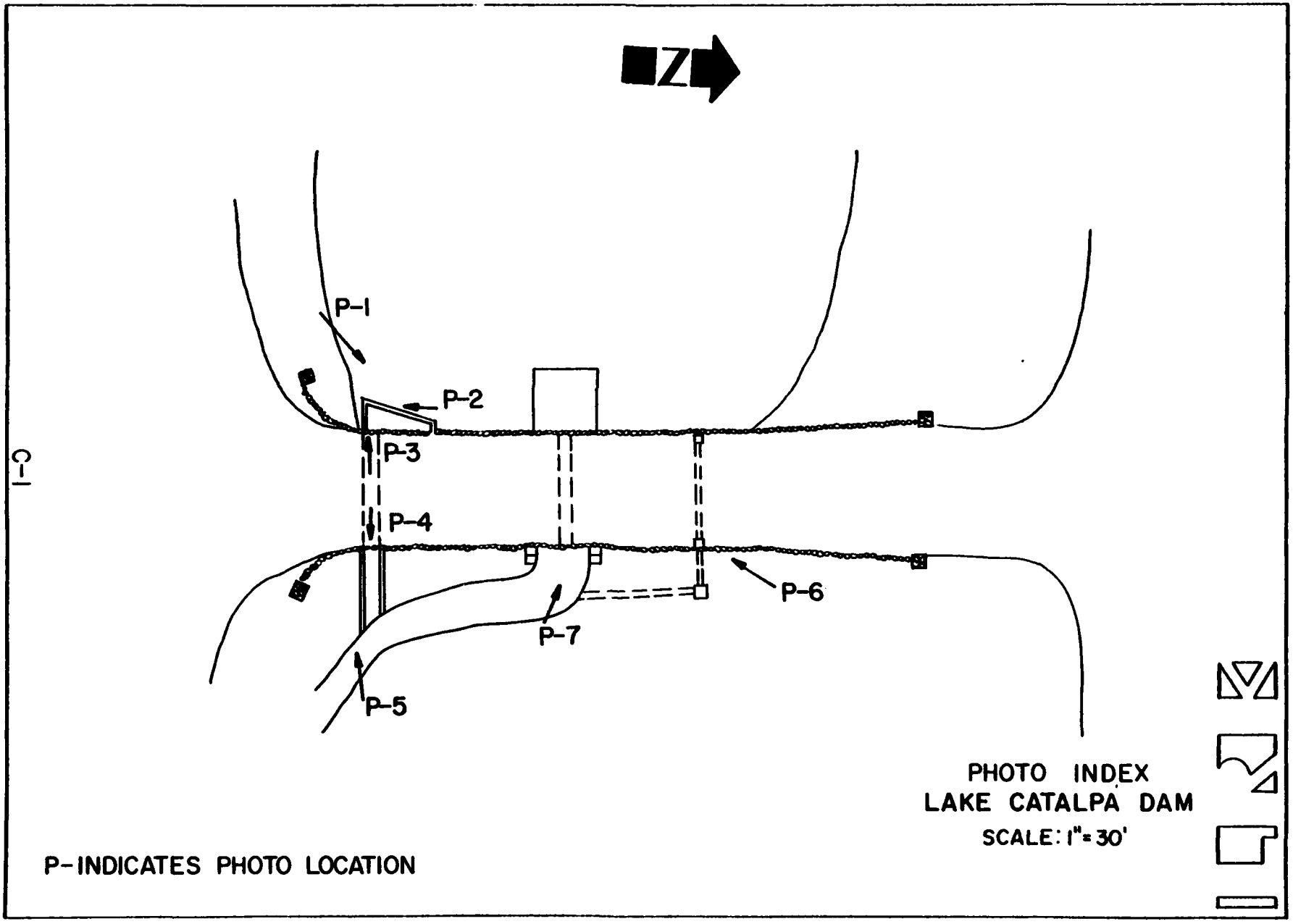
ITEM	REMARKS
AS-BUILT DRAWINGS	None.
REGIONAL VICINITY MAP	U.S.G.S. quadrangle.
CONSTRUCTION HISTORY	None.
TYPICAL SECTIONS OF DAM	None available.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS RAINFALL/RESERVOIR RECORDS	None. None. None. None. None.

ITEM	REMARKS
DESIGN REPORTS	None.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None.
POST-CONSTRUCTION SURVEYS OF DAM	None.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	In 1966 concrete buttresses and walls were installed.
HIGH POOL RECORDS	Top of the fish screens.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Several inspection reports available in DER files.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Unknown.
MAINTENANCE OPERATION RECORDS	Concrete walls drainline gate operated and lubricated semi-annually. Fish screens are cleaned on a regular basis.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	None available.
OPERATING EQUIPMENT PLANS & DETAILS	None available.

APPENDIX C
PHOTOGRAPHS


N
P-1
P-2
P-3
P-4
P-5
P-6
P-7
C-1
PHOTO INDEX
LAKE CATALPA DAM
SCALE: 1"= 30'
P-INDICATES PHOTO LOCATION

LAKE CATALPA DAM
PA 560

Photograph Description

Sheet 1

Front

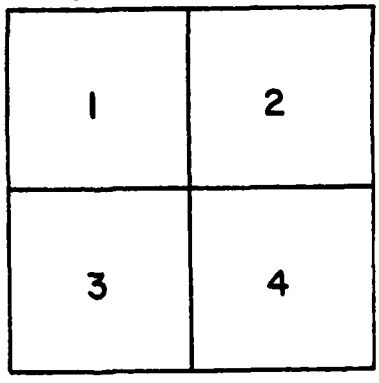
(1) Upper left - View of upstream face of dam. Note fish screen which spans the spillway crest.
(2) Upper right - Spillway crest. Note rigid steel frame fish screen.
(3) Lower left - View of spillway crest, fish screen and entrance to culvert.
(4) Lower right - View of culvert outlet and outlet channel.

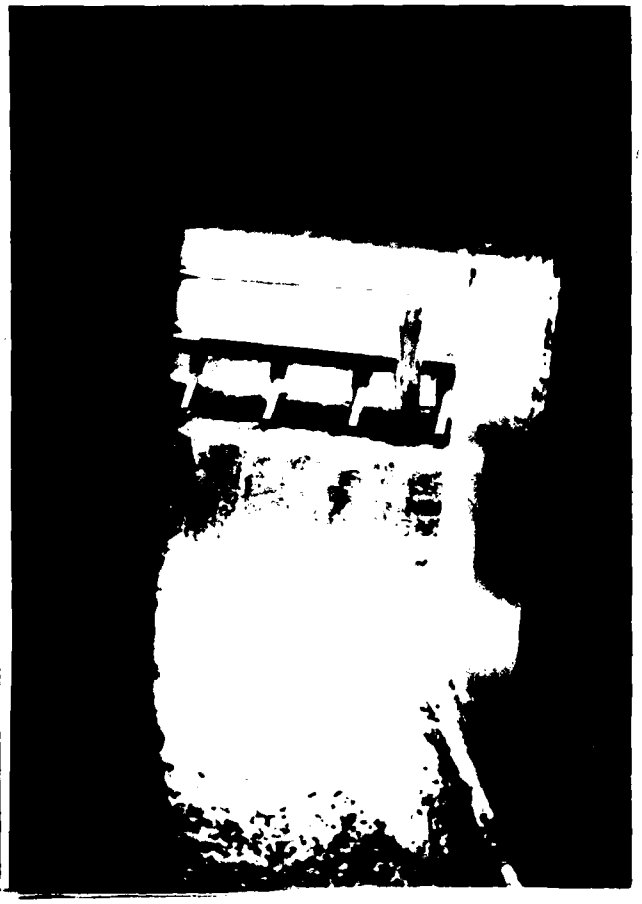
Sheet 2

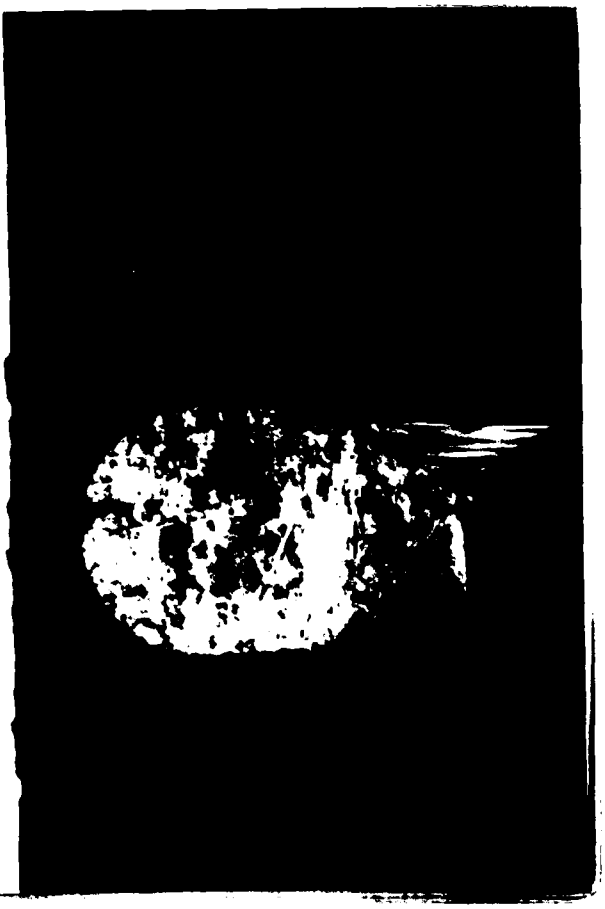
Back

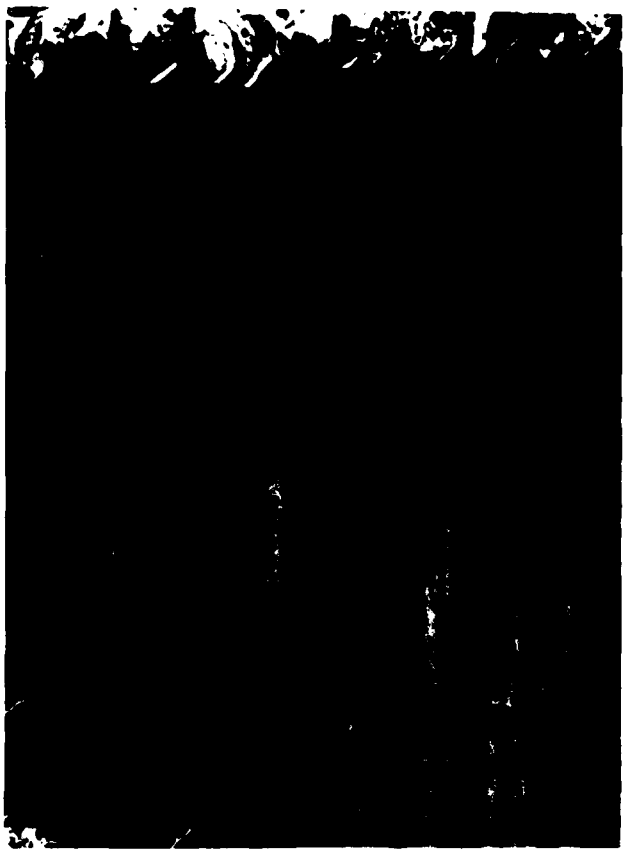
(5) Upper left - View of culvert outlet and discharge channel. View looking upstream.
(6) Upper right - Concrete and masonry on downstream face of dam.
(7) Lower left - View of downstream face of dam at the outlet point for the drainline.
(8) Lower right - Downstream exposure.

TOP OF PAGE









APPENDIX D
HYDROLOGY AND HYDRAULICS

APPENDIX D
HYDROLOGY AND HYDRAULICS

Methodology. The dam overtopping and breach analyses were accomplished using the systemized computer program HEC-1 (Dam Safety Investigation), September, 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. A brief description of the methodology used in the analysis is presented below.

1. Precipitation. The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Report No. 40" prepared by the U.S. Weather Bureau.

The index rainfall is reduced from 10% to 20% depending on watershed size by utilization of what is termed the HOP Brook adjustment factor. Distribution of the total rainfall is made by the computer program using distribution methods developed by the Corps.

2. Inflow Hydrograph. The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing.

The unit hydrograph is developed using the Snyder method. This method requires calculation of several key parameters. The following list gives these parameters their definition and how they were obtained for these analysis.

Parameter	Definition	Where Obtained
Ct	Coefficient representing variations of watershed	From Corps of Engineers*
L	Length of main stream channel miles	From U.S.G.S. 7.5 minute topgraphic
Lca	Length on main stream to centroid of watershed	From U.S.G.S. 7.5 minute topographic
Cp	Peaking coefficient	From Corps of Engineers*
A	Watershed size	From U.S.G.S. 7.5 minute topographic

*Developed by the Corps of Engineers on a regional basis for Pennsylvania.

3. Routing. Reservoir routing is accomplished by using Modified Plus routing techniques where the flood hydrograph is routed through reservoir storage. Hydraulic capacities of the outlet works, spillways and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of the outlet works can either be calculated and input or sufficient dimensions input and the program will calculate an elevation discharge relationship.

Storage in the pool area is defined by an area - elevation relationship from which the computer calculates storage. Surface areas are either planimetered from available mapping or U.S.G.S. 7.5 minute series topographic maps or taken from reasonably accurate design data.

4. Dam Overtopping. Using given percentages of the PMF the computer program will calculate the percentage of the PMF which can be controlled by the reservoir and spillway without the dam overtopping.

5. Dam Breach and Downstream Routing. The computer program is equipped to determine the increase in downstream flooding due to failure of the dam caused by overtopping. This is accomplished by routing both the pre-failure peak flow and the peak flow through the breach (calculated by the computer with given input assumptions) at a given point in time and determining the water depth in the downstream channel. Channel cross-sections taken from U.S.G.S. 7.5 minute topographic maps were used in the downstream flood wave routing. Pre and post failure water depths are calculated at locations where cross-sections are input.

HYDROLOGY AND HYDRAULICS ANALYSIS
DATA BASE

NAME OF DAM: Lake Catalpa Dam

PROBABLE MAXIMUM PRECIPITATION (PMP) = 22.2 (0.97) = 21.5 inches

STATION	1	2	3
Station Description	Lake Catalpa Dam		
Drainage Area (square miles)	2.10		
Cumulative Drainage Area (square miles)	2.10		
Adjustment of PMF for Drainage Area (%)(1)			
6 hours	117		
12 hours	127		
24 hours	136		
48 hours	143		
72 hours	145		
Snyder Hydrograph Parameters			
Zone (2)	11		
Cp (3)	0.62		
Ct (3)	1.50		
L (miles) (4)	2.35		
Lca (miles) (4)	0.75		
tp = Ct(LxLca) 0.3 hrs.	1.78		
Spillway Data			
Crest Length (ft)	26'		
Freeboard (ft)	5.5		
Discharge Coefficient	Varies		
Exponent	Varies		

(1) Hydrometeorological Report 40 (Figure 1), U.S. Army Corps of Engineers, 1965.

(2) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's coefficients (C_p and C_t).

(3) Snyder's Coefficients.

(4) L=Length of longest water course from outlet to basin divide. L_{ca}=Length of water course from outlet to point opposite the centroid of drainage area.

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 2.10 mi^2 wooded slopes

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 529 ac-ft

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1031 ac-ft

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 1275.4 at right abutment 1277.6 - top of stone wall

SPILLWAY CREST:

a. Elevation 1271.5 - top of fish screen
b. Type Sharp crest - concrete ogee with culvert
c. Width Crest height - 26 feet
d. Length
e. Location Spillover Right abutment
f. Number and Type of Gates None

OUTLET WORKS:

a. Type 30" pipe - material unknown
b. Location Through embankment
c. Entrance inverts Unknown
d. Exit inverts Unknown
e. Emergency draindown facilities 30" pipe - material unknown

HYDROMETEOROLOGICAL GAUGES:

a. Type None
b. Location None
c. Records None

MAXIMUM NON-DAMAGING DISCHARGE: Unknown

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EBENSBURG PENNSYLVANIA

DAM NAME Lake Catalpa Dam
I.D. NUMBER 40-57 (PA 560)
SHEET NO. 1 OF 7
BY DGM DATE June 30 1980

Loss Rate And Base Flow Parameters

As Recommended By Corps Of Engineers

Baltimore District

STRTL = 1 inch

CNSTL = .05 in/hr

STRTQ = 1.5 cfs/mi²

QRCSN = 0.05 (5% of peak flow)

RTIOR = 2.0

Elevation - Storage Capacity Relationships

From USGS 7.5 min Quad., DER Files

And Field Inspection Data.

Elev.	Area (Ac)	Average Area (Ac)	ΔEL (ft)	ΔStor (Ac-ft)	E Storage
1264.5*	0				0
		38.85	3.5	135.98	
1268.0	77.7				136
		93.85	1.5	140.78	
1269.5	110.0				277
		125.75	5.5	691.62	
1275.0	141.5				969
		153.85	5.0	769.25	
1280.0	166.2				1738

* Value Of "Zero" Area Extrapolated Using Photographs, Quad. And DER Files.

(See Chart Next Page)

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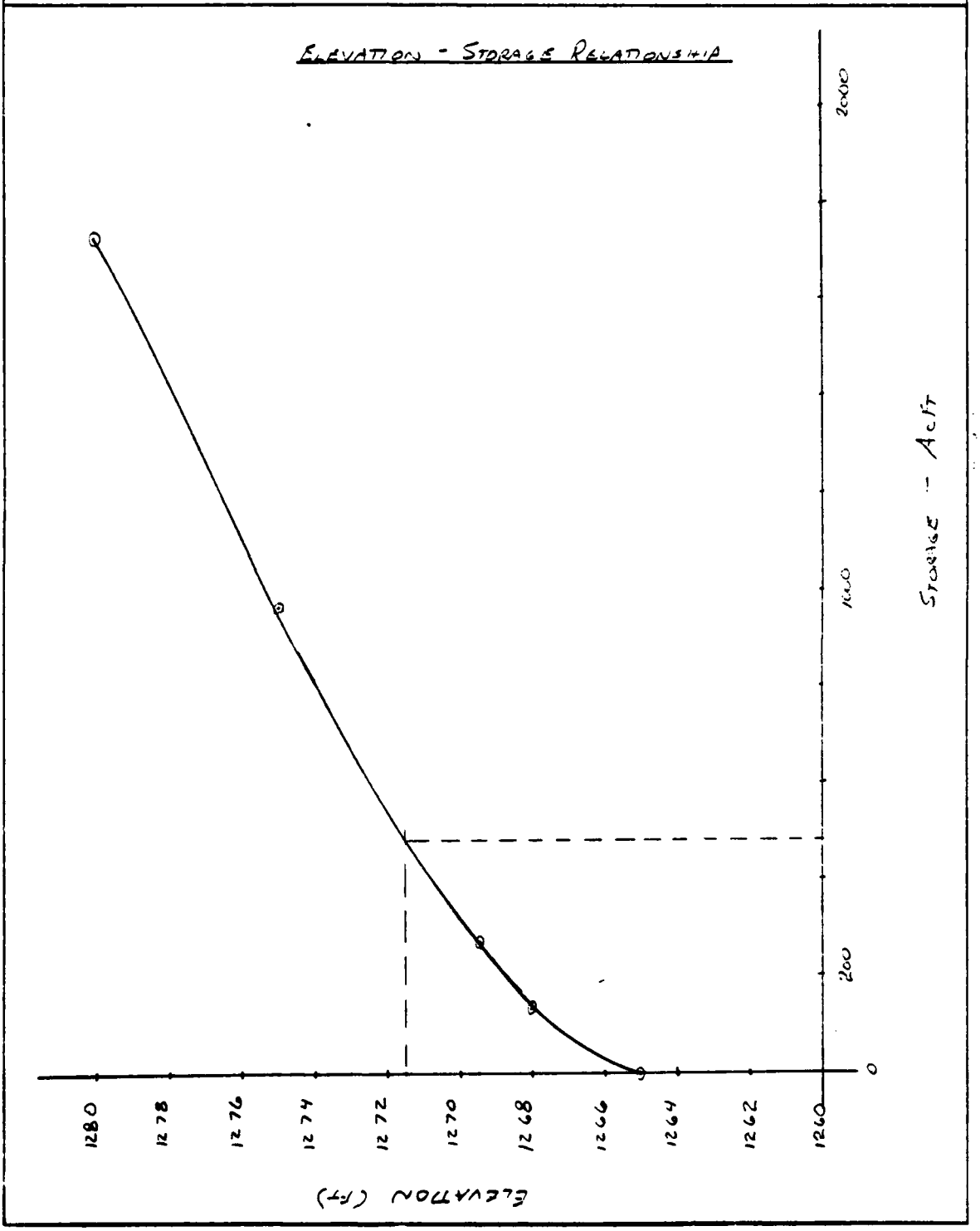
DAM NAME Lake Catalda Dam
I.D. NUMBER 40-57 (PA-560)
SHEET NO. 2 OF 7
BY DGM DATE June 30, 1980



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EBENSBURG PENNSYLVANIA

DAM NAME LAKE CATALPA DAM
I.D. NUMBER 42-57 (PA-562)
SHEET NO. 3 OF 7
BY DGM DATE JULY 1, 1980

OVERTOP PARAMETERS

TOP OF DAM ELEVATION (LOW SPOT) - 1275.45
LENGTH OF DAM - 200.0
COEFFICIENT OF DISCHARGE - 3.0

$L	4'	25'	71'	117'	171'	183'
$V	1275.4	1277.6	1278.0	1278.5	1279.0	1279.5

DISCHARGE RATING CURVE

THE OVERFLOW WEIR IS A THREE-SIDED STRUCTURE PROJECTED INTO THE LAKE. WEIR FLOW BEGINS OVER THIS OGEE SPILLWAY CREST AT ELEVATION 1271.5. THE CREST LENGTH IS APPROXIMATELY 26 FEET. DAM OVERTOPPING WEIR FLOW WILL BEGIN AT APPROXIMATELY ELEVATION 1275.4. BETWEEN ELEVATIONS 1271.5 AND 1275.4 THERE WILL BE A COMBINATION OF WEIR AND PRESSURE FLOW AS DETERMINED BY THE CURVE ON PAGE 7 OF 7.

DEVELOPED USING THE FOLLOW EQUATIONS:

WEIR FLOW: $Q = C L H^{1.5}$

PRESSURE FLOW: $Q = CA\sqrt{2gh}$

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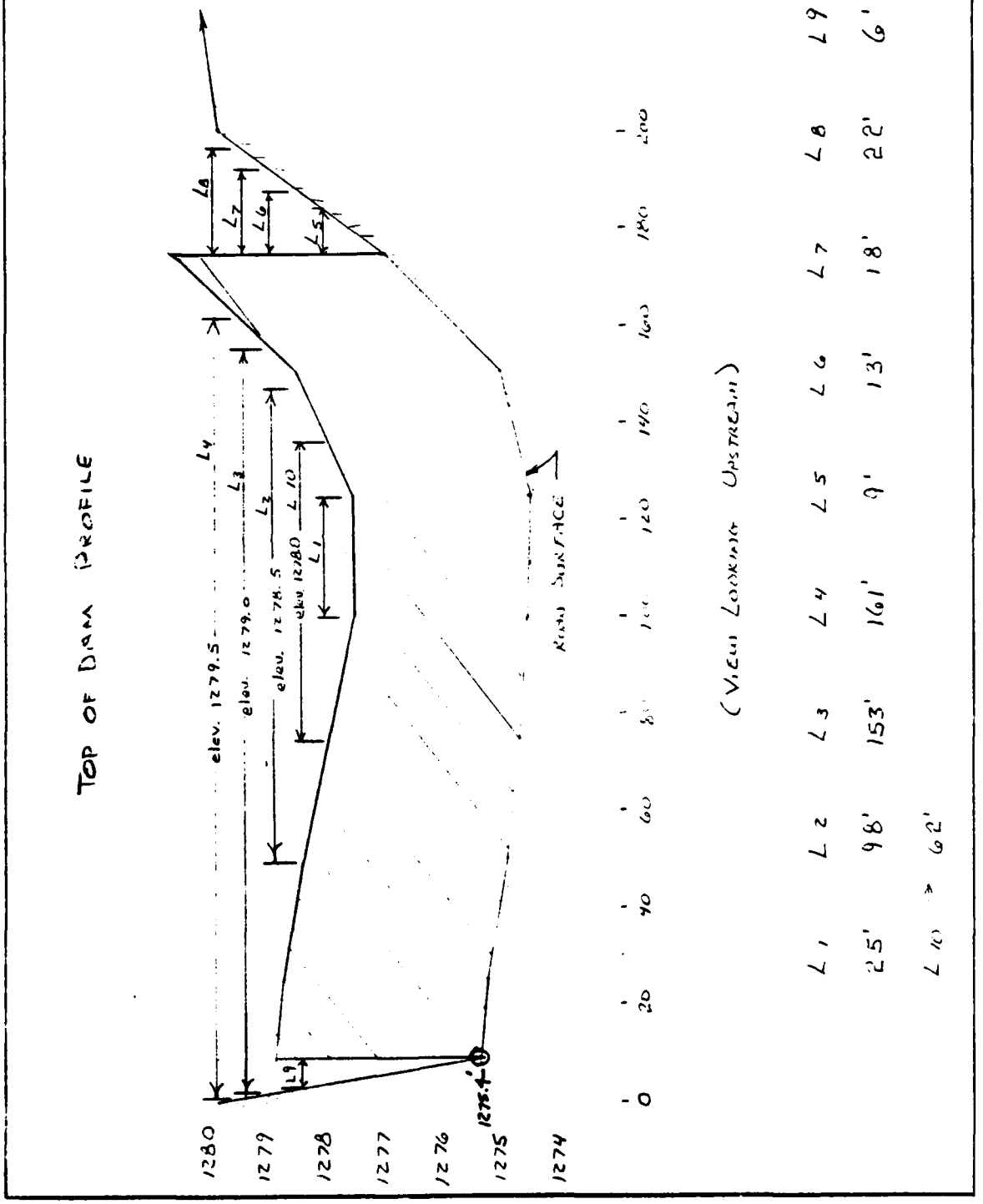
DAM NAME LAKE CATALDO DAM
I.D. NUMBER 40-57 (DA-57)
SHEET NO. 4 OF 7
BY DGM DATE JULY 1, 1981



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EBENSBURG PENNSYLVANIA

DAM NAME LAKE SAMUEL DAM
I.D. NUMBER 40-57 (OA-560)
SHEET NO. 5 OF 7
BY DGH DATE JULY 1, 1980

DISCHARGE VARIABLES

WEIR FLOW (SPILLWAY)

C = 3.6 (SHARP CREST TO OGEE)
L = 26'
H = VARIABLE

WEIR FLOW (OVERTOPPING)

C = 3.0, (BROAD CREST)
L = 200'
H = VARIABLE

PRESSURE FLOW (SPILLWAY)

C = ~~1/√K~~ = 0.80
A = AREA = 48.9 ft²
g = 32.2 ft/sec²
h = POOL ELEV - CULVERT ENTRANCE INVERT ELEV
(culvert length = 30')

SOURCE:

WATER AND WASTEWATER ENGINEERING:
by; FAIR, GEYER, OKUM, 1966

Low Dams: by, NATIONAL RESOURCES COMMITTEE, WASHINGTON D.C.

HANDBOOK OF APPLIED HYDRAULICS
by: DAVIS, SORENSEN

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EBENSBURG PENNSYLVANIA

DAM NAME LAKE [illegible] DAM
I.D. NUMBER 40-57 (PA-500)
SHEET NO. 6 OF 7
BY DGM DATE JULY 1, 1980

EMERGENCY SPILLWAY DISCHARGE CALCULATIONS

$Q = CLH^{1.5}$ $Q = CA\sqrt{2gh}$

ELEV.	WEIR FLOW		FULL PIPE		DISCHARGE *
(ft)	h (ft)	Q (cfs)	h (ft)	Q (cfs)	Q (cfs)
** 1271.5	0	0	6.1		0
1272.0	0.5	23	6.6		35
1272.5	1.0	94	7.1		95
1273.0	1.5	172	7.6		170
1273.5	2.0	265	8.1	~~875~~	265
1274.0	2.5	370	8.6	~~921~~	370
1274.5	3.0	486	9.1	~~947~~	485
1275.0	3.5	613	9.6	~~973~~	615
1275.5	4.0	749	10.1	~~998~~	750
1276.0	4.5	894	10.6	~~1022~~	895
1276.5	5.0	1046	11.1	1046	1045
1277.0	5.5	~~1207~~	11.6	1069	1070
1277.5	6.0	~~1376~~	12.1	1092	1090
1278.0	6.5	~~1551~~	12.6	1114	1115

* Q ROUNDED TO NEAREST 5 cfs
** THESE CALCULATIONS ASSUMED THAT THE FISH SCREEN IS BLOCKED

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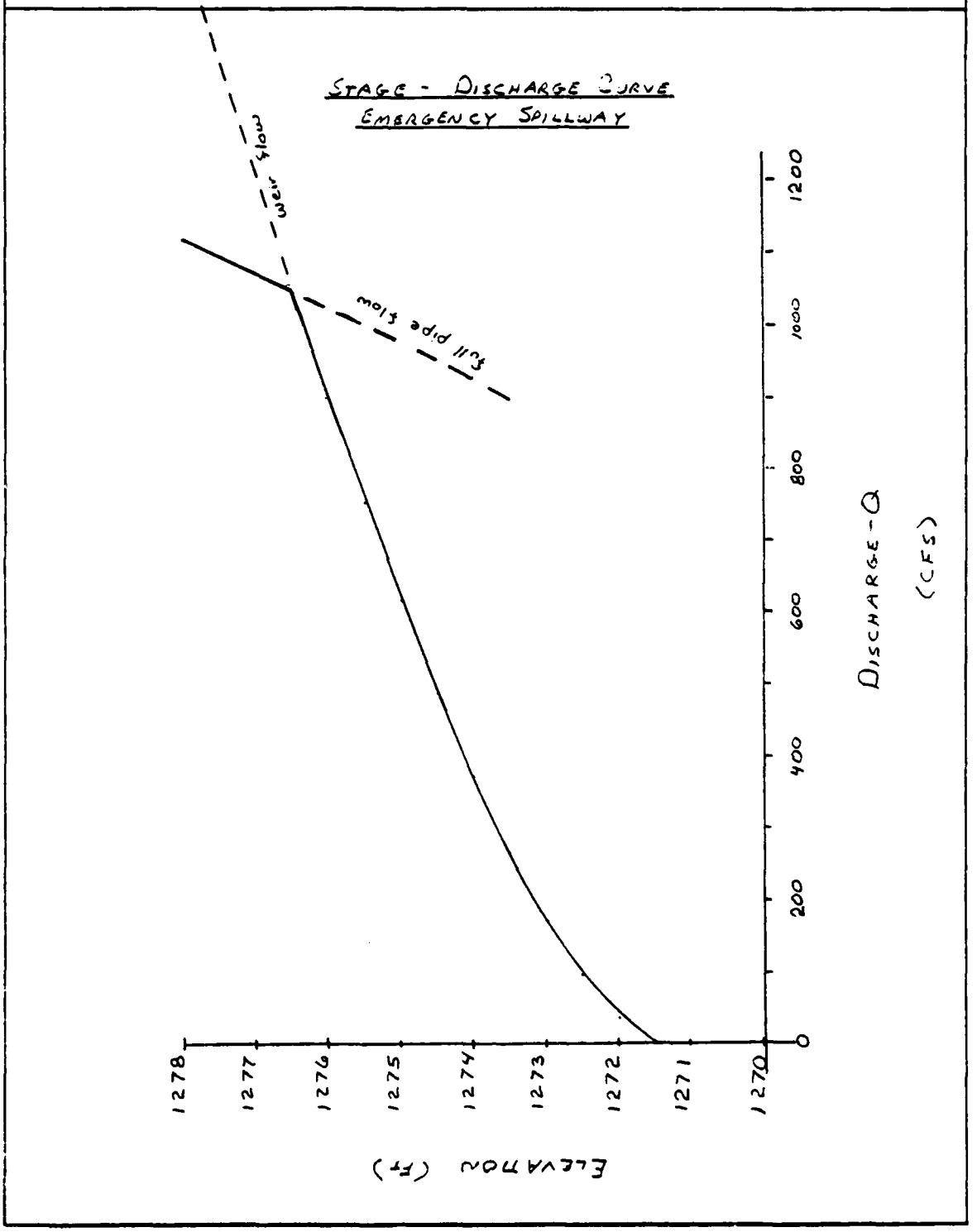
EBENSBURG PENNSYLVANIA

DAM NAME Lake Catalpa Dam
I.D. NUMBER 40-57 (PA-560)
SHEET NO. 7 OF 7
BY JGM DATE July 1, 1980

Stage - Discharge Curve
Emergency Spillway



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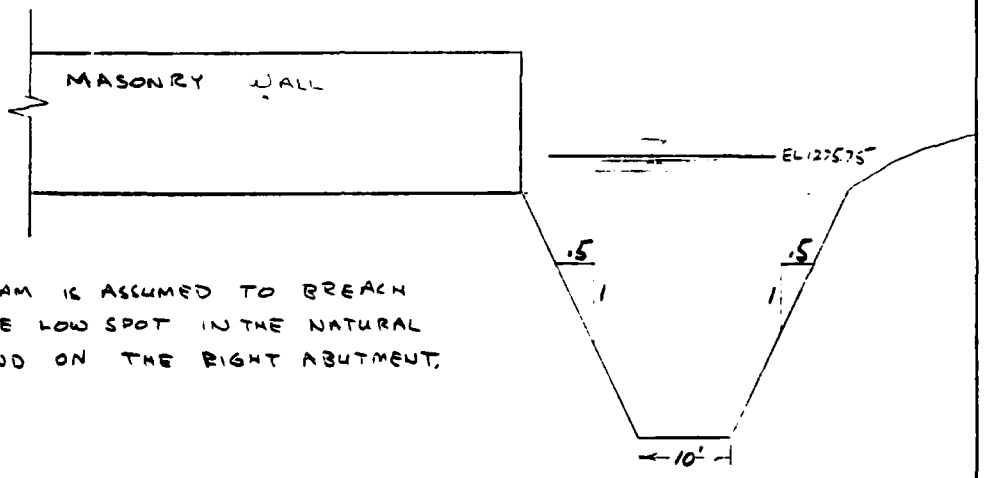
EBENSBURG PENNSYLVANIA

NAME LAKE CATALPA
NUMBER 40-57 (HA 560)
SHEET NO. ____ OF ____
BY CAE DATE 7-5-84

BREACH PARAMETERS

VIEW LOOKING DOWNSTREAM
(NOT TO SCALE)



THE DAM IS ASSUMED TO BREACH AT THE LOW SPOT IN THE NATURAL GROUND ON THE RIGHT ABUTMENT.

BREACH WIDTH (BRWID) = 10'
SIDE SLOPE (Z) = 0.5
BOTTOM ELEV. (ELBM) = 1265
FAILURE TIME (TFAIL) = 4 HRS
INITIAL WATER ELEV (WSEL) = 1271.5
FAILURE ELEV. (FAILEL) = 1275.75

CHANNEL ROUTING PARAMETERS

CROSS SECTIONS OBTAINED FROM A U.S.G.S. 7.5 MIN. QUAD.

MANNINGS' n:
CHANNEL = .05
OVERBANK = .06

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
    1          A1       ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
    2          A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF THE LAKE CATALPA DAM
    3          A3       RATIOS OF PMF ROUTED THROUGH THE RESERVOIR (560)
    4          B    288       0      15       0       0       0       0       0      -5       0
    5          B1     5
    6          J      1       6       1
    7          J1   0.2     0.3     0.4     0.5    0.75       1
    8          K      0       1                                       1
    9          K1       INFLOW TO RESERVOIR
   10          N      1       1    2.10                                                       1
   11          P           81.5     117     127     136     143     145
   12          T                                                   140    0.09
   13          W   1.78    0.62
   14          X   -1.5    -.05     2.0
   15          K      1       2                                       1
   16          K1       ROUTE THRU RESERVOIR
   17          Y                                       1       1
   18          Y1     1                                                -1271.5      -1
   19          Y41271.5  1272.0  1272.5  1273.0  1273.5  1274.0  1274.5  1275.0  1275.5  1276.0
   20          Y41276.5  1277.0  1277.5  1278.0
   21          Y5     0      35      95     170     265     370     485     615     750     895
   22          Y5  1045    1070    1090.    1115
   23          S5     0     136     277     969    1738
   24          SE1264.5  1268.0  1269.5  1275.0  1280.0
   25          S$1271.5
   26          SD1275.4     3.0     1.5     200
   27          SL     4      25      71     117     171     183
   28          SV1275.4  1277.6  1278.0  1278.5  1279.0  1279.5
   29          K     99
```

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

RUN DATE= 80/09/09.
TIME= 05.58.06.

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF THE LAKE CATALPA DAM
RATIOS OF PMF ROUTED THROUGH THE RESERVOIR (S60)

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	15	0	0	0	0	0	-4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 6 LRTIO= 1

RTIOS= .20 .30 .40 .50 .75 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	2.10	0.00	2.10	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.50	117.00	127.00	136.00	143.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 1.78 CP= .62 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 39 END-OF-PERIOD ORDINATES, LAG= 1.76 HOURS, CP= .63 VOL= 1.00

24.	90.	179.	280.	376.	448.	486.	484.	438.	375.
321.	275.	236.	202.	173.	148.	127.	108.	93.	80.
68.	58.	50.	43.	37.	31.	27.	23.	20.	17.

14. 12. 11. 9. 8. 7. 6. 5. 4.

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	24.94	22.35	2.59	122909.
										(633.)	(568.)	(66.)	(3480.40)

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1272.	-1

STAGE	1271.50	1272.00	1272.50	1273.00	1273.50	1274.00	1274.50	1275.00	1275.50
//1276.00									
	1276.50	1277.00	1277.50	1278.00					
FLOW	0.00	35.00	95.00	170.00	265.00	370.00	485.00	615.00	750.00
//1895.00									
	1045.00	1070.00	1090.00	1115.00					
CAPACITY=	0.	136.	277.	969.	1738.				
ELEVATION=	1269.	1268.	1270.	1275.	1280.				

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1271.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1279.4	3.0	1.5	200.

CREST LENGTH	4.	25.	71.	117.	171.	183.
AT OR BELOW ELEVATION	1275.4	1277.6	1278.0	1278.5	1279.0	1279.5

PEAK OUTFLOW IS 390. AT TIME 44.25 HOURS

PEAK OUTFLOW IS 657. AT TIME 44.25 HOURS

PEAK OUTFLOW IS 918. AT TIME 44.00 HOURS

PEAK OUTFLOW IS 1123. AT TIME 44.25 HOURS

PEAK OUTFLOW IS 1929. AT TIME 44.00 HOURS

PEAK OUTFLOW IS 3440. AT TIME 43.25 HOURS

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .20	RATIO 2 .30	RATIO 3 .40	RATIO 4 .50	RATIO 5 .75	RATIO 6 1.00
HYDROGRAPH AT	1	2.10 (5.44)	1	1148. (32.51)	1722. (48.76)	2296. (65.01)	2870. (81.27)	4305. (121.90)	5740. (162.53)
ROUTED TO	2	2.10 (5.44)	1	390. (11.05)	687. (18.61)	918. (26.01)	1123. (31.79)	1929. (54.63)	3440. (97.40)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1271.50	1271.50	1279.40
STORAGE	529.	529.	1031.
OUTFLOW	0.	0.	723.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	1274.09	0.00	854.	390.	0.00	44.25	0.00
.30	1275.18	0.00	993.	657.	0.00	44.25	0.00
.40	1276.04	.64	1130.	918.	5.00	44.00	0.00
.50	1276.94	1.54	1267.	1123.	7.75	44.25	0.00
.75	1279.15	3.75	1607.	1929.	12.00	44.00	0.00
1.00	1280.49	5.09	1814.	3440.	13.75	43.25	0.00

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
    1          A1      RATIOS OF PMF ROUTED THROUGH THE RESERVOIR AND DOWNSTREAM
    2          A2      DOWNSTREAM CONDITION DUE TO OVERTOPPING OF LAKE CATALPA DAM
    3          A3      PLAN 1 ASSUMES BREACH. PLAN 2 ASSUMES NO BREACH
    4          B    288       0        15        0         0         0         0         0        -4        0
    5          B1     5
    6          J      2       1         1
    7          J1    .4
    8          K      0       1                                                  1
    9          K1       INFLOW TO RESERVOIR
   10          M      1       1      2.10                                                        1
   11          P             21.8      117       127       136       149       148
   12          T                                                              1.0      0.05
   13          Q    1.78     0.62
   14          X   -1.5      -.05      2.0
   15          K      1       2                                                  1
   16          K1       ROUTE THRU RESERVOIR
   17          Y                                          1         1
   18          Y1     1                                                      -1271.5       -1
   19          Y41271.5  1272.0    1272.5    1273.0    1273.5    1274.0    1274.5    1275.0    1275.5    1276.0
   20          Y41276.5  1277.0    1277.5    1278.0
   21          YS     0       35        95       170       265       370       485       615       750       895
   22          YS  1045    1070      1090.     1115
   23          SS     0      136       277       969      1738
   24          SE1264.5  1268.0    1269.5    1275.0    1280.0
   25          SS1271.5
   26          SD1278.4      3.0       1.5       200
   27          SL     4       25        71       117       171       183
   28          SV1278.4  1277.6    1278.0    1278.5    1279.0    1279.5
   29          SB    10      .5      1265       4.0    1271.5   1275.75
   30          SB    10      .5      1265       4.0    1271.5    1280.0
   31          K      1       3                                                  1
   32          K1       ROUTE DOWNSTREAM REACH NO. 1
   33          Y                                          1         1
   34          Y1     1
   35          Y6   .06     .05       .06      1178      1220      3500       .02
   36          Y7     0    1220       150      1200       600      1180       604      1178       609      1178
   37          Y7   613    1180      1150      1200      1425      1220
   38          K      1       4                                                  1
   39          K1       ROUTE DOWNSTREAM REACH NO. 2
   40          Y                                          1         1
   41          Y1     1
   42          Y6   .06     .05       .06      1038      1080      3000       .05
   43          Y7     0    1080       175      1060       200      1040       204      1038       209      1038
   44          Y7   213    1040       275      1060       375      1080
   45          K     99
```

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

RUN DATE= 80/09/09.
TIME= 12.59.37.

RATIOS OF PMF ROUTED THROUGH THE RESERVOIR AND DOWNSTREAM
DOWNSTREAM CONDITION DUE TO OVERTOPPING OF LAKE CATALPA DAM
PLAN 1 ASSUMES BREACH, PLAN 2 ASSUMES NO BREACH

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	15	0	0	0	0	0	-4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 2 NRTIO= 1 LRTIO= 1
RTIOS= .40

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	2.10	0.00	2.10	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.50	117.00	127.00	136.00	143.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 1.78 CP= .62 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 39 END-OF-PERIOD ORDINATES, LAG= 1.76 HOURS, CP= .63 VOL= 1.00

24.	90.	179.	280.	376.	448.	486.	484.	438.	375.
321.	279.	236.	202.	173.	148.	127.	108.	93.	80.
68.	58.	50.	43.	37.	31.	27.	23.	20.	17.

14. 12. 11. 9. 8. 7. 6. 5. 4.

END-OF-PERIOD FLOW

HO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	HO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	24.94	22.35	2.59	122909.
										(633.)(568.)(66.)(3480.40)			

HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

CLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	=1272.	=1.

STAGE	1271.50	1272.00	1272.50	1273.00	1273.50	1274.00	1274.50	1275.00	1275.50
1276.00	1276.50	1277.00	1277.50	1278.00					
FLOW	0.00	38.00	95.00	170.00	269.00	370.00	483.00	619.00	790.00
1895.00	1048.00	1070.00	1090.00	1115.00					
CAPACITY=	0.	136.	277.	969.	1738.				
ELEVATION=	1269.	1268.	1270.	1275.	1280.				

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1271.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1279.4	3.0	1.5	200.

CREST LENGTH	4.	29.	71.	117.	171.	183.
AT OR BELOW ELEVATION	1275.4	1277.6	1278.0	1278.5	1279.0	1279.5

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
10.	.50	1265.00	4.00	1271.50	1275.78

BEGIN DAM FAILURE AT 43.00 HOURS

PEAK OUTFLOW IS 1670. AT TIME 47.00 HOURS

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL

10. .50 1265.00 4.00 1271.50 1280.00

PEAK OUTFLOW IS 918. AT TIME 44.00 HOURS

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE DOWNSTREAM REACH NO. 1

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0600	.0500	.0600	1178.0	1220.0	3500.	.02000

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 1220.00 150.00 1200.00 600.00 1180.00 604.00 1178.00 609.00 1178.00
613.00 1180.00 1150.00 1200.00 1425.00 1220.00

STORAGE	0.00	1.75	15.60	48.81	101.41	173.38	264.72	375.44	505.54
655.01	823.85	1006.03	1196.96	1395.42	1602.64	1818.19	2042.09	2274.33	2514.92
2763.84									
OUTFLOW	0.00	114.72	1061.64	4292.56	10958.91	22027.66	38368.03	60779.95	90013.44
126778.97	172074.43	232210.27	300590.12	377214.68	462126.40	555396.82	657118.29	767398.47	886356.41 1
014119.77									
STAGE	1178.00	1180.21	1182.42	1184.63	1186.84	1189.05	1191.26	1193.47	1195.68

1197.89

	1200.11	1202.32	1204.53	1206.74	1208.95	1211.16	1213.37	1215.58	1217.79
1220.00									
FLOW	0.00	114.72	1061.64	4292.56	10958.51	22027.66	38368.03	60779.95	90013.44
126778.97									
	172074.43	232210.27	300590.12	377214.68	462126.40	555396.82	657118.29	767398.47	886356.41 1
014119.77									

MAXIMUM STAGE IS 1182.8

MAXIMUM STAGE IS 1182.1

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE DOWNSTREAM REACH NO. 2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPRP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0600	.0500	.0600	1038.0	1080.0	3000.	.05000

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 1080.00 175.00 1060.00 200.00 1040.00 204.00 1038.00 209.00 1038.00
219.00 1040.00 279.00 1060.00 379.00 1080.00

STORAGE	0.00	1.43	4.29	8.60	14.38	21.62	30.33	40.50	52.13
1265.23									
	79.79	97.55	119.94	146.95	178.59	214.86	255.75	301.27	351.42
1406.20									
OUTFLOW	0.00	180.14	841.92	2068.37	3969.47	6648.16	10201.59	14722.11	20298.00
027014.12									
	34838.01	42612.41	53139.30	66438.85	82744.33	102334.84	125496.69	152512.50	183657.98
219201.28									
STAGE	1038.00	1040.21	1042.42	1044.63	1046.84	1049.05	1051.26	1053.47	1055.68
1057.89									
	1060.11	1062.32	1064.53	1066.74	1068.95	1071.16	1073.37	1075.58	1077.79
1080.00									
FLOW	0.00	180.14	841.92	2068.37	3969.47	6648.16	10201.59	14722.11	20298.00
227014.12									
	34838.01	42612.41	53139.30	66438.85	82744.33	102334.84	125496.69	152512.50	183657.98
219201.28									

MAXIMUM STAGE IS 1043.9

MAXIMUM STAGE IS 1042.6

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 .40
HYDROGRAPH AT	1	2.10 (5.44)	1	2296. (65.01)
			2	2296. (65.01)
ROUTED TO	2	2.10 (5.44)	1	1670. (47.28)
			2	918. (26.01)
ROUTED TO	3	2.10 (5.44)	1	1653. (46.80)
			2	917. (25.98)
ROUTED TO	4	2.10 (5.44)	1	1647. (46.63)
			2	917. (25.97)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	1271.50	1271.50	1275.40
	STORAGE	929.	929.	1031.
	OUTFLOW	0.	0.	723.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.40	1276.01	.61	1124.	1670.	3.67	47.00	48.00

PLAN 2		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	1271.50	1271.50	1275.40
	STORAGE	929.	929.	1031.
	OUTFLOW	0.	0.	723.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.40	1276.04	.64	1130.	918.	5.00	44.00	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.40	1653.	1182.8	47.00

PLAN 2 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.40	917.	1182.1	44.25

PLAN 1 STATION 4

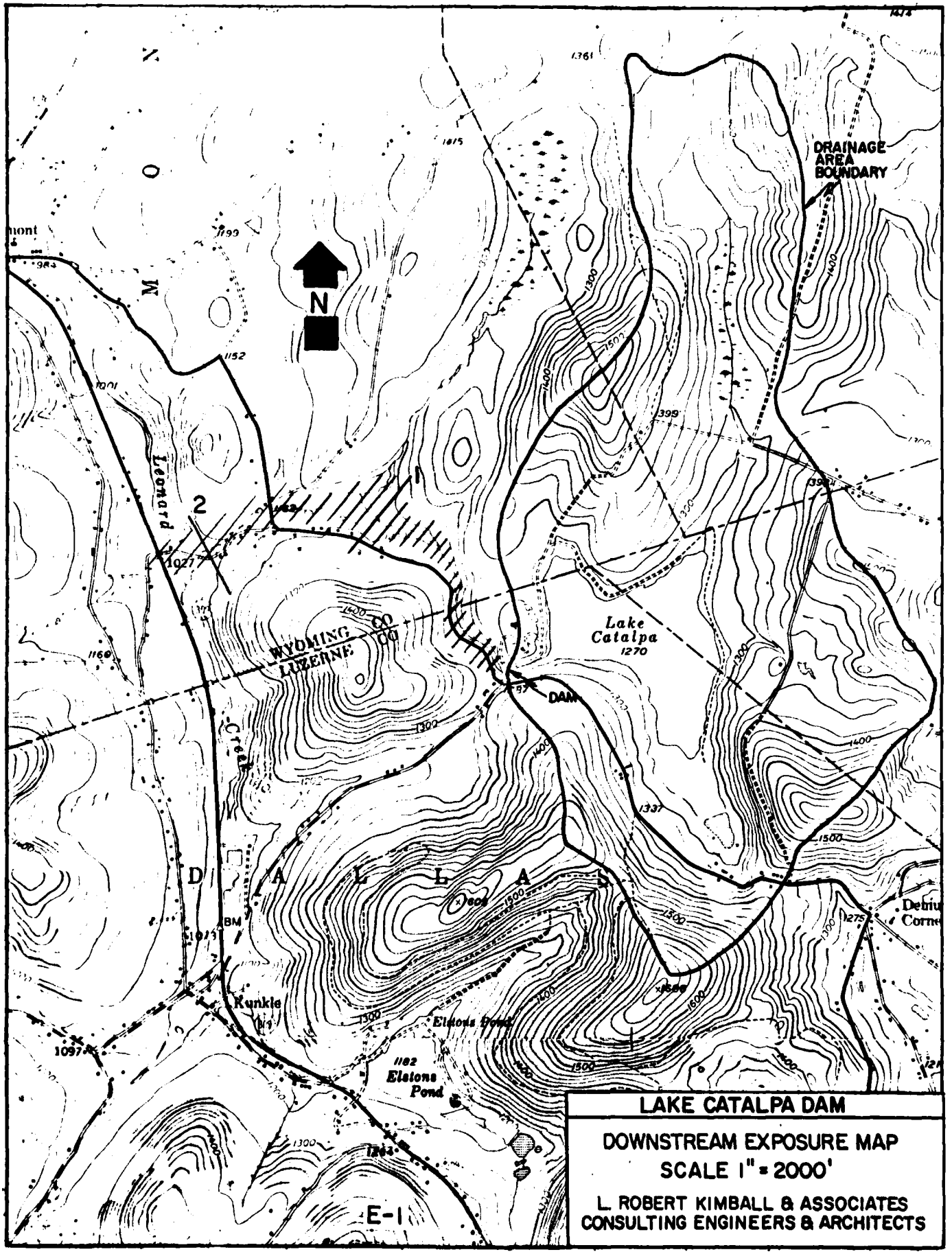
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS

.40	1617.	1043.9	47.00

PLAN 2 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.40	917.	1042.6	44.25

APPENDIX E
DRAWINGS

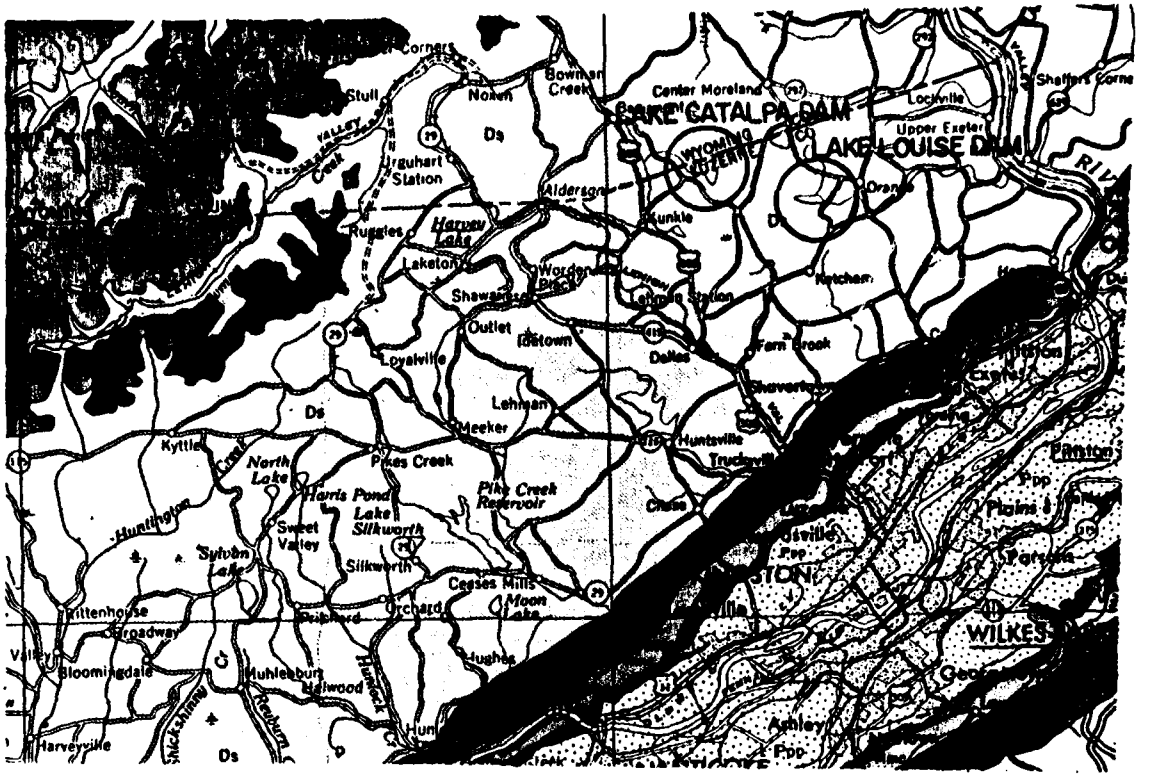

DRAINAGE AREA BOUNDARY
N
Leonard
2
WYOMING
LUZERNE
CO
CO
Lake Catalpa
1270
DAM
Creek
D A L L A S
BM
1013
Kunkle
Elsions Pond
1182
Elsions Pond
1097
E-1
LAKE CATALPA DAM
DOWNSTREAM EXPOSURE MAP
SCALE 1" = 2000'
L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS

APPENDIX F
GEOLOGY

General geology

Lake Catalpa and its dam lie within the (Glaciated) Low Plateaus Section of the Appalachian Plateaus Physiographic Province. This area is characterized by broad anticlines and synclines and little, it any, faulting. There are no known faults in the vicinity of the dam.

The rocks underlying the lake and dam consists of the Devonian aged Susquehanna Group. This is a complex unit of conglomerate, sandstone, siltstone and shale. The usually well developed bedding ranges in thickness from less than one to over fifteen feet. The well developed joints are regular and closely spaced in the shales and siltstones. They are vertical or steeply dipping and ususally form a blocky or platy pattern. The shales disintegrate rapidly, but the siltstone, sandstone and conglomerate are fairly resistant to weathering. The rocks of the Susquehanna Group form a good foundation for heavy structures if excavated to sound material and the shales and siltstones are kept water-free. The interstitial porosity of the coarser rocks is low, but joint development has created a medium level of total effective porosity.



GEOLOGIC MAP OF THE AREA AROUND LAKE CATALPA DAM AND LAKE LOUISE DAM

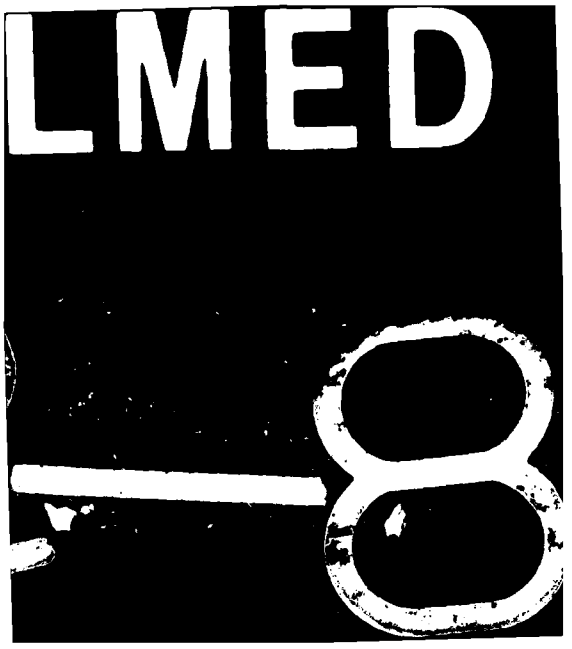
Oswayo Formation
Brownish and greenish gray, fine and medium grained sandstones with some shales and scattered calcareous lenses; includes red shales which become more numerous eastward. Relation to type Oswayo not proved.

Dck — **Catskill Formation**
Chiefly red to brownish shales and sandstones; includes gray and greenish sandstone tongues named Elk Mountain, Honesdale, Shohola, and Delaware River in the east.

Dm — **Marine beds**
Gray to olive brown shales, graywackes, and sandstones; contains "Chemung" beds and "Portage" beds including Burket, Brallier, Harrell, and Trimmers Rock; Tully Limestone at base.

Ds — **Susquehanna Group**
Barbed line is "Chemung-Catskill" contact of Second Pennsylvania Survey County reports; barbs on "Chemung" side of line.

SCALE 1:250,000


LMED